BELLCOMM, INC.
955 L'ENFANT PLAZA NORTH, S.W. WASHINGTON, D. C. 20024

B70 12006

SUBJECT: Effect of Manual TLI Guidance on S-IVB Injection Capability Case 310

DATE: December 2, 1970

FROM: L. P. Gieseler

MEMORANDUM FOR FILE

It is planned that in case of failure of the guidance system during or before TLI, the crew may provide attitude control manually (see Reference 1). A constant pitch rate will be used, rather than the pitch rate determined by the guidance equations. Simulations of the S-IVB second burn have been made to determine whether or not a propellant penalty results from the use of a constant pitch rate.

The operational trajectory profile and a constant pitch profile were simulated. The pitch rate from the operational trajectory follows approximately a parabolic law, starting at -.11 degrees/sec at the beginning of TLI, increasing to a maximum of -.032 degrees/sec at the center of the burn, and decreasing to about -.11 degrees/sec at the end of the burn.

A constant pitch rate value of -.058 degrees/sec was determined by a targeting run to achieve the same TLI terminal conditions. A comparison of the two cases is given below:

	Length of TLI burn	Injected Weight
Apollo 14 pitch rate profile	353.30 sec.	140,094 lbs.
Constant pitch rate profile	353.32 sec.	140,085 lbs.

The results show that the constant pitch rate profile is slightly inferior to that produced by the launch vehicle guidance, injecting 9 lbs less into a translunar trajectory. Thus, the manual guidance employing a constant pitch rate should not adversely affect the injection capability of the S-IVB to a significant extent.

REFERENCES

1. D. R. Anselmo and L. P. Gieseler, "Manual TLI Engine Cutoff Calculation," Bellcomm Memorandum for File B70 10044, October 21, 1970.

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